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DERWENT-ACC-NO: 1992-270954

DERWENT-WEEK: 199233

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TITLE: Power control circuit for electric heater e.g. of electric cooker - uses temp. sensors for each hotplate to regulate semiconductor switching device controlling energy supply and has CPU for controlling firing angles

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PRIORITY-DATA: 1991GB-0001067 (January 17, 1991)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-
IPC				
GB 2252647 A	August 12, 1992	N/A	012	G05D
023/19				

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
GB 2252647A	N/A	1991GB-0001067	January 17, 1991

INT-CL (IPC): G05D023/19, H05B001/02

ABSTRACTED-PUB-NO: GB 2252647A

BASIC-ABSTRACT:

The power control circuit controls the thermal output of electric heaters such as the hotplates and grill and oven heaters of an electric cooker. For each hotplate and heater (1-4,20), a temp. sensor (15-18,21) is settable to a partic. temp. and responsive to the temp. of the hotplate or heater, and a

Fig. 1
3:3-23
5:21-26

semiconductor switching device (7-10) regulates the supply of electrical energy to the hotplate or heater.

A central processor unit (19) has inputs from the sensors and outputs to the switching devices and so controls the firing angle of the switching devices that the energy input to each heater is directly proportional to the extent of the difference between the sensed and set temp. values. The central processor unit (19) may also control a visual display unit (23) for displaying the temp. of one or other of the hotplates or heaters.

USE/ADVANTAGE - Also for room heaters or water heaters. Uses power more efficiently than thermostatic control.

CHOSEN-DRAWING: Dwg.1/1

**TITLE-TERMS: POWER CONTROL CIRCUIT ELECTRIC HEATER ELECTRIC COOKER TEMPERATURE
SENSE HOTPLATE REGULATE SEMICONDUCTOR SWITCH DEVICE
CONTROL ENERGY
SUPPLY CPU CONTROL FIRE ANGLE**

DERWENT-CLASS: T06 X25 X27

EPI-CODES: T06-B; X25-B; X27-C02; X27-E01A; X27-E03A;

SECONDARY-ACC-NO:

Non-CPI Secondary Accession Numbers: N1992-207143

PUB-NO: GB002252647A

DOCUMENT-IDENTIFIER: GB 2252647 A

TITLE: Power control circuits for electric heaters

PUBN-DATE: August 12, 1992

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APPL-NO: GB09101067

APPL-DATE: January 17, 1991

PRIORITY-DATA: GB09101067A (January 17, 1991)

INT-CL (IPC): G05D023/19, H05B001/02

EUR-CL (EPC): F24C015/10 ; G05D023/22

US-CL-CURRENT: 236/6

ABSTRACT:

CHG DATE=19990617 STATUS=O> A power control circuit for controlling the thermal output of electric heaters such as the hotplates and grill and oven

heaters of an electric cooker comprises, for each hotplate and heater 1-4, 20,
a temperature sensor 15-18, 21 settable to a particular temperature and responsive to the temperature of the hotplate or heater, and a semi-conductor
switching device 7-10 for regulating the supply of electrical energy to the hotplate or heater. A central processor unit 19 has inputs from the sensors and outputs to the switching devices and so controls the firing angle of the switching devices that the energy input to each heater is directly proportional
to the extent of the difference between the sensed and set temperature values.
The central processor unit 19 may also control a visual display unit 23 for displaying the temperature of one or other of the hotplates or heaters.
Water
or room heaters may alternatively be controlled. <IMAGE>

(12) UK Patent Application (19) GB (11) 2 252 647 (13) A

(43) Date of A publication 12.08.1992

(21) Application No 9101067.8

(22) Date of filing 17.01.1991

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(51) INT CL⁵
G05D 23/19, H05B 1/02

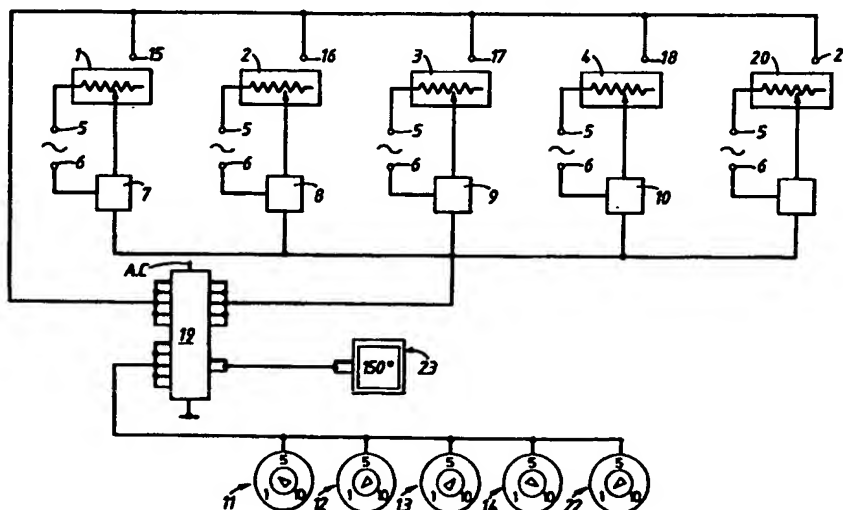
(52) UK CL (Edition K)
G3R RA25 RA33 RA623 RA625 RBQ42 RBQ45
RBQ46 RB4723 RB473 RB4762
U1S S1976 S1978 S2400

(56) Documents cited
GB 2163574 A GB 2073455 A GB 2060329 A
US 4720623 A US 4493980 A

(58) Field of search
UK CL (Edition K) G3R RBQ39 RBQ42 RBQ44
RBQ45 RBQ46 RBQ52 RBQ59
INT CL⁵ G05D, H05B
Online databases: WPI

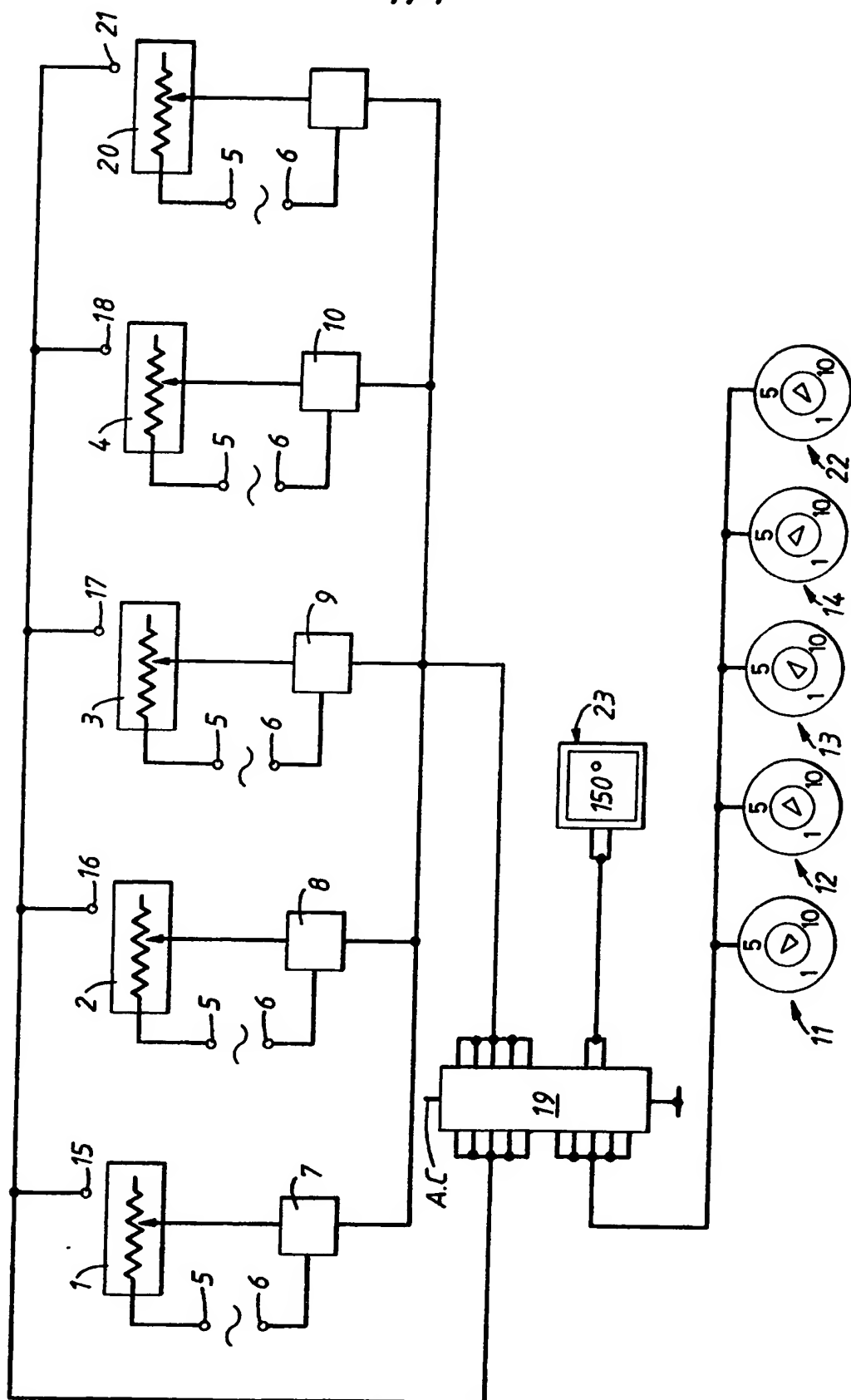
(54) Power control circuits for electric heaters

(57) A power control circuit for controlling the thermal output of electric heaters such as the hotplates and grill and oven heaters of an electric cooker comprises, for each hotplate and heater 1-4, 20, a temperature sensor 15-18, 21 settable to a particular temperature and responsive to the temperature of the hotplate or heater, and a semi-conductor switching device 7-10 for regulating the supply of electrical energy to the hotplate or heater. A central processor unit 19 has inputs from the sensors and outputs to the switching devices and so controls the firing angle of the switching devices that the energy input to each heater is directly proportional to the extent of the difference between the sensed and set temperature values. The central processor unit 19 may also control a visual display unit 23 for displaying the temperature of one or other of the hotplates or heaters. Water or room heaters may alternatively be controlled.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.
The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.
This print incorporates corrections made under Section 117(1) of the Patents Act 1977.

GB 2 252 647 A



Improvements in or relating to power control circuits.

5 This invention relates to power control circuits
and has particular reference to power control circuits for
domestic appliances. The domestic appliances are those
incorporating electric resistance heater elements for example,
electric cooking appliances, electric water heaters, electric
storage and room heaters, and sandwich toasters.

10 In such appliances, it is conventional practice to
incorporate some form of thermostatic control that can be
preset by a user and which terminates the supply of electrical
power to the heater when a preset temperature is reached
and subsequently so to control the supply that the preset
15 temperature is maintained for as long as the appliance is in
use. The temperature may be that of an electric hotplate, oven
or grill in the case of a cooking appliance or the heater of
a sandwich heater, or it may be room temperature in the case
of a storage or other form of room heater, or water
20 temperature in the case of a water heater.

 The thermostatic control operates a switch that is
closed to supply power to the heater of the appliance and is
opened to terminate the supply. Thus, the power supply is
either fully "ON" or "OFF". Such a control is wasteful of
25 electrical power because of the inherent thermal hysteresis
of the heater. It is found that the temperature of the heater
continues to increase for a short time after the supply of
power ceases and the supply of power is not resumed until

after the temperature has dropped below the preset value. Thus, the temperature fluctuates above and below the preset value.

5 It is an object of the present invention to provide a control circuit which allows a more efficient use to be made of the electrical power available.

10 According to the present invention an arrangement for controlling the thermal output of one or more electric heaters comprises, for the or each heater, a temperature sensor settable to a particular temperature and responsive to a temperature associated with the heater, and a semi conductor switching device for regulating the supply of electrical energy to the heater, the arrangement also comprising a central processor unit to which the or each sensor inputs, the unit being programmed so to control the firing angle of the or each switching device that, in use, the energy input to the or each heater is modulated in a manner such that the input is directly proportional to the extent of the difference between the sensed and set temperature values.

20 The arrangement preferably includes control means for enabling the set temperature to be varied. The control means will usually incorporate an "ON" - "OFF" switch for bringing the heater into use.

25 The switching device may be a thyristor or a triac or some equivalent switching device.

By way of example only, an embodiment of the invention will now be described in greater detail with

reference to the accompanying drawing which shows the control arrangement in block schematic form only.

The embodiment is suitable for an electric cooker with hotplates comprising electric resistance heaters, four of these being shown in the drawing as resistors 1,2,3, and 4. Electrical power is supplied to the heaters 1...4 from ac input terminals 5, 6 and the supply of power is regulated by silicon controlled rectifiers 7,8,9 and 10 respectively. The rectifiers may be, for example, thyristors, triacs or some other equivalent solid state switching device.

Each heater has respective control means shown in the drawing as blocks 11, 12, 13 and 14 and each of which is a user operated control for switching the heater ON and OFF and for setting the temperature at which the heater is to operate.

The control means may be of the rotary type with preset positions, for example, "LOW", "MEDIUM" and "HIGH" or they may be of the continuously variable type with a dial graduated in degrees centigrade or fahrenheit.

Associated with the heaters 1.... 4 are sensors 15, 16 ,17 and 18 respectively which respond to the temperature of the heaters. Preferably, the sensors are thermocouples which may be of Type K.

The control means and the sensors all input to a central processor unit shown schematically as block 20 and which processes those inputs to provide output signals to determine the firing angles of the rectifiers 7... 10. The

unit 19 may be a Type Z80 or it may be simply a read only memory.

Unit 19 and the control means 1114 are not powered directly from the supply that powers the heaters 1....4 but from a suitable low voltage source e.g. a 24 volt dc supply which may, of course, be derived from the ac supply that powers the heaters.

Regulation of the energy supply is effected by varying the firing angle of the rectifiers 7... 10 in direct proportion to the extent of the difference between the value of the temperature sensed by a sensor and that of the temperature to which the control means is set.

With all the control means 11.... 14 in their "OFF" positions, the heaters 1....4 are de-energised and the hotplate are cold. When one of the control means is operated to its "ON" position and set to a required temperature, the relevant SCR is triggered into conduction with a maximum firing angle and therefore power at maximum value is applied to the heater . As the temperature of the hotplate rises, the sensor responds to that increase and inputs to the unit 19 which also responds and decreases the firing angle of the SCR and this results in a progressive reduction of the power supplied to the heater as the sensed temperature rises, and the difference between the value of the sensed temperature and the set temperature value reduces. Eventually, the temperature of the hotplate reaches the value preset by the user and the unit responds and then turns the SCR off and the supply of power to the heater stops. The hotplate temperature

then falls and the difference between the sensed temperature value and the set temperature value increases and this is signalled to the unit 19 by the temperature sensor and the unit 19 then responds and returns the SCR to a conducting state with a firing angle proportional to the extent of the difference between the set and sensed temperature and power is once again supplied to the heater. The hotplate temperature will continue to fall for a short period and during that time the firing angle is progressively increased so that the power supplied to the heater is progressively increased to a point at which the hotplate temperature starts to increase. The increase is sensed by the sensor which signals to the unit 19 and the latter responds and decreases the firing angle progressively as the extent of the difference between the sensed and set temperatures reduces. When that extent becomes zero, the SCR is turned off.

In that way, the hotplate temperature is maintained closely at the set temperature and "hunting" is minimised with the consequential minimisation of the consumption of electrical energy.

It will be appreciated that, normally, the cooker oven heating element and grill heating element will be provided with similar controls which input to the central processor unit 19 and the drawing shows an oven heater 20, an associated temperature sensor 21, control means 22 and power supply input 5,6.

If desired, a visual display may also be provided to show temperature. Such display, indicated by block 23, is

also controlled by the central processing unit 19 as indicated in the drawing. The display may be associated permanently with one of the heaters, for example the oven heater, or it may be selectively associated with any one of those heaters.

5 The small size of the central processor unit and the printed circuit board on which it is mounted means that it can readily be accommodated within the structure of the domestic appliance. The large storage capacity of the unit allows it to be programmed to control a considerable number of heaters and thus the unit can be common to, for example, a range of
10 cookers and does not have to be specially programmed for each individual cooker.

 Maintenance is simple because, in many cases, faults can be rectified by replacing the central processor unit.

15 The electric heater may be that of a storage or other form of room heater in which case the sensor will be exposed to ambient air temperature in the vicinity of the heater. In the case of a storage water heater, the sensed temperature may be that of water stored in the heater.

20 Apart from the saving in power consumption input referred to above, savings in both cost and size result from the use of low voltage components for the control means and the sensors . The electrical standards for low voltage components are less stringent than those for mains supply
25 voltage components and their physical size is smaller.

Claims.

1. An arrangement for controlling the thermal output of one or more electric heaters comprising, for the or each heater, a temperature sensor responsive to a temperature associated with the heater, and a semi-conductor switching device for regulating the supply of electrical energy to the heater, the arrangement also comprising a central processor unit to which the or each sensor inputs, the unit being programmed so to control the or each switching device that, in use, the energy input to the or each heater is modulated in a manner such that the energy input is proportional to the extent of the difference between the temperature sensed by the heater sensor and a preset temperature.
2. An arrangement as claimed in claim 1 in which the or each control means is such as to enable it to determine the preset temperature.
3. An arrangement as claimed in claim 1 or 2 in which the or each control means incorporates an ON/OFF switch for controlling the energisation and de-energisation of its associated heater.
4. An arrangement as claimed in claim 1, 2 or 3 in which the or each switching device is a silicon controlled rectifier whose firing angle is controlled by the central processor unit.
5. An arrangement as claimed in claim 4 in which the rectifier is a thyristor or a triac.
6. An arrangement as claimed in any one of the preceding claims in which the unit comprises a micro-processor or comprises a read-only memory.
7. An arrangement as claimed in any one of the preceding claims in which the or each sensor comprises a thermocouple.
8. Electrical apparatus including an arrangement as claimed in any one of the preceding claims.
9. Apparatus as claimed in claim 8 and comprising an electric cooker and in which the electric heaters comprise the cooker hotplates and grill and oven heaters.
10. Apparatus as claimed in claim 9 and further comprising a temperature display unit that is controlled by the central

processor unit.

11. Apparatus as claimed in claim 10 in which the display unit is a visual display unit.

5 12. Apparatus as claimed in claim 10 or 11 in which the display unit is associated with the heater or is selectively associatable with one of the heaters to display the temperature of the heater.

10 13. Apparatus as claimed in any one of the preceding claims in which the control means and the sensors are low voltage components.

14. An arrangement for controlling the thermal output of several electric heaters substantially as herein described with reference to and as illustrated by the accompanying drawing.

Patents Act 1977

Examiner's report to the Comptroller under
Section 17 (The Search Report)

-9-

Application number

9101067.8

Relevant Technical fields

(i) UK CI (Edition K) G3R RBQ39, RBQ42, RBQ44, RBQ45
RBQ46, RBQ52, RBQ59

(ii) Int CL (Edition 5) G05D; H05B

Search Examiner

MR M J JONES

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE: WPI

Date of Search

27 APRIL 1992

Documents considered relevant following a search in respect of claims

1-14

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB A 2163574 (THORN) - See figure 3	1-6, 8
X	GB A 2073455 (APPLIANCE CONTROL) See figure 2	1-6, 8, 13
X	GB A 2060329 (THORN) - See figure 3	1-12
X	US 4720623 (DU PONT)	1-8
X	US 4493980 (GEC) - See column 12 line 9 to column 14 line 40, and figure 5	1-6, 8, 9, 13

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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